AMENDMENTS TO THE CLAIMS

The following is a complete listing of revised claims with a status identifier in parenthesis.

LISTING OF CLAIMS

1. (Currently Amended) A method of forming [[an]] a composite oxide layer on a substrate surface comprising:

exposing the substrate surface to a first precursor including an amino functional group to form a chemisorbed first precursor layer on the substrate surface; and

oxidizing the chemisorbed first precursor layer with [[an]] a first oxidant to form [[the]] a first oxide layer on the substrate surface;

exposing the first oxide layer to a second precursor containing an amino functional group to form a chemisorbed second precursor layer on the first oxide layer;

oxidizing the second precursor layer with a second oxidant to form a second oxide layer on the first oxide layer; wherein

the first and second precursors are different.

2. (Currently Amended) A method of forming [[an]] a composite oxide layer according to claim 1, wherein[[;]]

at least one of the first and second precursor is represented by a chemical formula of MX_n,

with M representing one element selected from the group consisting of elements found in groups 2, 3A including lanthanide, 4A, 5A, 3B, 4B and 5B of the periodic table,

X representing $-NR_1R_2$ wherein R_1 and R_2 independently selected from a group consisting of hydrogen and alkyl groups having 1-4 carbon atoms,

and n represents the integer 2, 3, 4 or 5.

3. (Currently Amended) A method of forming [[an]] a composite oxide layer according to claim 2, wherein[[:]]

M is an element selected from the group consisting of Sr, Ba, Y, La, Ti, Zr, Hf, V, Nb, Ta, Al, Ge, Pb, As, Sn, Si and Bi.

4. (Currently Amended) A method of forming [[an]] a composite oxide layer according to claim 3, wherein[[:]] M is hafnium.

5. (Currently Amended) A method of forming [[an]] a composite oxide layer according to claim 1, wherein[[:]]

at least one of the first and second [[the]] precursor is at least one selected from the group consisting of TEMAH, TDEAH, TDMAH, $Hf[N(C_3H_7)_2]_4$, $Hf[N(C_4H_9)_2]_4$, $Ti[N(CH_3)C_2H_5]_4$, $Zr[N(CH_3)C_2H_5]_4$, $Sn[N(CH_3)C_2H_5]_4$, $Si[N(CH_3)C_2H_5]_4$, $Ta[N(CH_3)C_2H_5]_5$, $Al[N(CH_3)C_2H_5]_3$ and $(CH_3)_2AlNH_2$.

6. (Currently Amended) A method of forming [[an]] a composite oxide layer according to claim 1, wherein[[:]]

at least one of the first and second [[the]] oxidant is at least one ~~oxidant~~ selected from the group consisting of H_2O_2, H_2O, O_3, N_2O, NO_2, plasma O_2, remote plasma O_2 and plasma N_2O.

7. (Currently Amended) A method of forming [[an]] a composite oxide layer according to claim 6, wherein at least one of the first and second [[the]] oxidant is O_3.

8. (Currently Amended) A method of forming a thin oxide film on a semiconductor substrate, the method comprising~~, in order~~:

~~(a) installing the semiconductor substrate within a chamber;~~

[[(b)]] (a) introducing a volume of a first precursor having an amino functional group into [[the]] a chamber under conditions that will cause a portion of the first precursor to chemisorb on [[the]] a semiconductor substrate and form a first precursor layer;

[[(c)]] (b) removing from the chamber substantially all of the volume of the first precursor that is not incorporated in the first precursor layer;

[[(d)]] (c) introducing a volume of [[an]] a first oxidant into the chamber;

[[(e)]] (d) reacting a portion of the first oxidant with the first precursor layer to form [[an]] a first ~~atomic~~ thin film ~~an oxide~~ on the semiconductor substrate; [[and]]

[[(f)]] (e) removing ~~from the chamber~~ an unreacted volume of the first oxidant from the chamber;

(f) introducing a volume of a second precursor having an amino functional group into the chamber under conditions that will cause a portion of the second precursor to chemisorb on the first thin film and form a second precursor layer;

(g) removing from the chamber substantially all of the volume of the second precursor that is not incorporated in the second precursor layer;

(h) introducing a volume of a second oxidant into the chamber;

(i) reacting a portion of the second oxidant with the second precursor layer to form a second thin film; and

(j) removing from the chamber an unreacted volume of the second oxidant from the chamber; wherein

the first and second precursors are different.

9. (Currently Amended) A method of forming a thin oxide film according to claim 8, wherein[[:]]

at least one of the first and second [[the]] precursor includes at least one material selected from the group consisting of TEMAH, TDEAH, TDMAH, $Hf[N(C_3H_7)_2]_4$ and $Hf[N(C_4H_9)_2]_4$.

10. (Currently Amended) A method of forming a thin oxide film according to claim 8, wherein[[:]]

at least one of the first and second [[the]] oxidant includes at least one ~~oxidant~~ selected from the group consisting of H_2O_2, H_2O, O_3, N_2O, NO_2, plasma O_2, remote plasma O_2 and plasma N_2O.

11. (Currently Amended) A method of forming an oxide thin film according to claim 10, wherein[[:]]

at least one of the first and second [[the]] oxidant is O_3.

12. (Currently Amended) A method of forming a thin oxide film according to claim 8, wherein[[:]]

at least one of the first and second [[the]] precursor is introduced into the chamber at a temperature not greater than about 300 °C[[.]] and under a pressure not greater than about 0.4 Torr,

the at least one precursor being introduced into the chamber through the use of an inert carrier gas.

13. (Currently Amended) A method of forming a thin oxide film according to claim 8, wherein[[:]]

at least one of groups of steps ~~(b) through (f)~~ (a) through (e) and steps (f) through (j) are repeated at least once.

14. (Currently Amended) A method of forming a thin oxide film according to claim 8, wherein[[:]]

removing from the chamber substantially all of the volume of at least one of the first and second [[the]] precursor ~~that is not incorporated in the precursor layer~~ and removing the unreacted volume of at least one of the first and second [[the]] oxidant from the chamber includes introducing an inert gas into the chamber.

15. (Canceled)

16. (Currently Amended) A method of forming a capacitor according to claim [[15]] 22, wherein[[:]]

at least one of the first and second precursor ~~the precursor~~ is at least one compound selected from the group consisting of TEMAH, TDEAH, TDMAH, $Hf[N(C_3H_7)_2]_4$, $Hf[N(C_4H_9)_2]_4$, $Ti[N(CH_3)C_2H_5]_4$, $Zr[N(CH_3)C_2H_5]_4$, $Sn[N(CH_3)C_2H_5]_4$, $Si[N(CH_3)C_2H_5]_4$, $Ta[N(CH_3)C_2H_5]_5$, $Al[N(CH_3)C_2H_5]_3$ and $(CH_3)_2AlNH_2$.

17. (Currently Amended) A method of forming a capacitor according to claim [[15]] 22, wherein

at least one of the first and second ~~the~~ oxidant is at least one ~~oxidant~~ selected from the group consisting of H_2O_2, H_2O, O_3, N_2O, NO_2, plasma O_2, remote plasma O_2 and plasma N_2O.

18. (Currently Amended) A method of forming a capacitor according to claim [[15]] 22, wherein[[:]]

the first electrode has an aspect ratio of at least 10:1.

19. (Currently Amended) A method of forming a capacitor according to claim [[15]] 22, wherein[[:]]

the first electrode includes a layer of at least one conductive material selected from the group consisting of doped polysilicon, metal nitrides and metals.

20. (Currently Amended) A method of forming a capacitor according to claim 19, wherein[[:]]

the first electrode includes a doped polysilicon layer and a nitride layer formed on a surface of the doped polysilicon layer.

21. (Currently Amended) A method of forming a capacitor according to claim [[15]] 22, wherein[[:]]

the second electrode includes a layer of at least one conductive material selected from the group consisting of doped polysilicon, metal nitrides and metals.

22. (Currently Amended) A method of forming a capacitor of a semiconductor device comprising:

(a) forming a first electrode on a semiconductor substrate;

(b) exposing the first electrode to a first precursor containing an amino functional group to form a chemisorbed first precursor layer on the first electrode;

(c) reacting the first precursor layer with an oxidant to form a first oxide dielectric layer on the first electrode;

(d) exposing the first oxide dielectric layer to a second precursor containing an amino functional group to form a chemisorbed second precursor layer on the first electrode;

(e) reacting the second precursor layer with an oxidant to form a second oxide dielectric layer on the first electrode, the first and second oxide dielectric layers cooperating to form a composite dielectric layer; and

(f) forming a second electrode on the composite dielectric layer; wherein the first and second oxide dielectric layers are different.

23. (Previously Presented) A method of forming a capacitor of a semiconductor device comprising:

(a) forming a first electrode on a semiconductor substrate;

(b) exposing the first electrode to a first precursor containing an amino functional group to form a chemisorbed first precursor layer on the first electrode;

(c) reacting the first precursor layer with an oxidant to form a first oxide dielectric layer on the first electrode;

(d) exposing the first oxide dielectric layer to a second precursor containing an amino functional group to form a chemisorbed second precursor layer on the first electrode;

(e) reacting the second precursor layer with an oxidant to form a second oxide dielectric layer on the first electrode, the first and second oxide dielectric layers cooperating to form a composite dielectric layer; and

(f) forming a second electrode on the composite dielectric layer, wherein

the first and second oxide dielectric layers are different and are selected from a group consisting of HfO_2, ZrO_2, Ta_2O_5, Y_2O_3, Nb_2O_5, TiO_2, CeO_2, In_2O_3, RuO_2, MgO, SrO, B_2O_3, SiO_2, GeO_2, SnO_2, PbO, PbO_2, V_2O_3, La_2O_3, As_2O_5, As_2O_3, Pr_2O_3, Sb_2O_3, Sb_2O_5, CaO and P_2O_5.

24. (Currently Amended) A method of forming a capacitor according to claim 23, wherein[[:]]

the first and second oxide dielectric layers are Al_2O_3 and HfO_2.

25. (Original) A method of forming a capacitor on a semiconductor device comprising:

forming a first electrode;

forming an oxide layer according to claim 1; and

forming a second electrode.

26. (Currently Amended) A method of forming an oxide layer according to claim 1, wherein[[:]]

at least one of the first and second [[the]] precursor is represented by a chemical formula of MX_nY_m,

with M representing one element selected from the group consisting of elements found in groups 2, 3A including lanthanide, 4A, 5A, 3B, 4B and 5B of the periodic table that has an oxidation state S,

X representing $-NR_1R_2$ wherein R_1 and R_2 are independently selected from a group consisting of hydrogen and alkyl groups having 1-4 carbon atoms,

and n represents the integer 1, 2, 3, 4 or 5, and

Y is selected from a group consisting of hydrogen, alkyl groups having 1-4 carbons and amino functional groups $-NR_3R_4$ wherein R_3 and R_4 are independently selected from a group consisting of hydrogen and alkyl groups having 1-4 carbons,

and m represents the integer 0, 1, 2, 3 or 4, and

wherein m and n satisfy the equation (m+n)=S.